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SWEET POTATO NUMBER

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Vol. III 1914 No. 6

Identification and Tests of Varieties of Sweet Potato

By Apolonio Ramos Muñoz

Thesis presented for graduation from the College of Agriculture, No. 18

So far as is known to me no variety tests and identifications of the sweet potato, nor any systematic investigation of this crop, have ever been undertaken in the Philippines. In order to furnish something of a basis for future investigation of this crop, the writer has undertaken to describe and to determine the comparative yields of such varieties of sweet potatoes as happened to be available. In the first paragraph of the preface of the thesis of Dr. B. H. A. Groth, on "THE SWEET POTATO," Philadelphia, June, 1906, we read: "It is now recognized among botanists in general, and physiologists and agriculturists in particular, that for obtaining reliable data the variety and not the species must form the basis of experiment."

Before giving the outline of the experiments, the writer wishes to acknowledge his indebtedness to the book of Dr. Groth, already cited, which has aided him very much, especially in the identification of the varieties. Acknowledgment are also due to Assistant Professor Cuzner, to whom the writer owes the general plan of the agronomy part of his experiment. The writer is under obligation to his brother and sister, Mr. Emigdio R. Muñoz and Miss Zoila Muñoz, for most of the varieties.

Outline

I. Description of Varieties.
- (A) Stem.
  1. Length.
  2. Diameter.
  3. Color, young and old.
  4. Presence of hairs.
- (B) Leaves.
  1. Shape.
  2. Size, across and longitudinal.
  3. Color, young and old.
  4. Color of veins.
  5. Presence of hairs.
  6. Presence of star.
- (C) Petiole.
  1. Length.
  2. Presence of hairs.
- (D) Character of vegetation.
- (E) Early or late maturers.
- (F) Liability to disease.
- (G) Tuber.
  1. Shape.
  2. Color of the skin.
  3. Color of the flesh.

4. Amount of latex.
5. Distinctness of wood element when cut.

(G') Cooked Tuber.

1. Color.
2. Odor.
3. Softness.
4. Flavor.
5. Sweetness.
6. Stringiness.

II. Comparative Yield of Varieties Under the Same Cultural Treatment.

III. Level and Ridge Cultures.

IV. Marketable Qualities, as Good, Fair and Poor.

V. Adaptation of Varieties to Purposes.

Owing to the fact that the sweet potato is almost universally cultivated, the question of its importance as a food plant is always opportune. In the tropics the sweet potato is a well-known plant and forms one of the staple crops in many lands. In Mexico, and in Central and South America, the sweet potato is considered a staple crop. In Africa the sweet potato is cultivated in all European colonies, as well as by many people of the interior. It is a well-known crop in Mediterranean Europe; and in Persia, India, Further India, China, Japan and the entire Malay Archipelago, the sweet potato forms one of the principal products and is used in many ways. In Australia and New Zealand it is also cultivated extensively. The reader is referred to Dr. Groth's book for complete information concerning the importance of the sweet potato. In the Philippines the sweet potato is everywhere grown, and the natives use the shoots or the young leaves, as well as the tubers, for food. In the markets of the cities one can often see bundles of young potato leaves or shoots for sale. Stock also relish the vines of sweet potato. Mr. Shiver, in the S. C. Expt. Sta. Bulletin 28, says that the green vines from 200 bushels of sweet potatoes will weigh approximately 9,500 pounds; this amount varies in different varieties, the variation being directly proportional to the character of vegetation, i. e., the more vigorous the vegetation is, the greater the quantity of vines.

Analyses of vines from four vigorous varieties, viz., Brazilian, Polo, Southern Queen and Nancy Hall, were made on September 29th, 1908, and are given in S. C. Agri. Expt. Sta., Bulletin 146, p. 15. The analyses were made as to the content of protein, fat, fiber, ash and nitrogen-free extract. The following table shows the average of the four varieties above mentioned:—

	Protein	*Fat*	*Fiber*	*Ash*	*Nitrogen-free extract*	*Total*
Average..	12.48	4.86	18.22	8.73	55.71	100

According to these analyses the vines have a very considerable feeding value, and the question arises as to whether it would be more profitable to feed the vines to stock and get the manure thereof, or to turn them into the soil as vines in order to form humus. In the same bulletin and page (15), it is stated that there is great trouble and consequently great expense in harvesting the vines, which are not only trailing but take root in many places. It is my personal opinion that under our conditions it is no more difficult to harvest sweet potato vines than to harvest any grass feeding stuff. It would surely be better, where it can be done cheaply, to gather the vines and feed to stock and then to apply the manure to the land.

Analyses of four other good feeding stuffs are also given in the same bulletin, p. 16, for comparison with the sweet potato vines.

The following shows the results of these analyses:—

Water-free	*Protein*	*Fat*	*Fiber*	*Ash*	*Nitrogen-free extract*
Red Clover Hay	14.52	3.90	29.28	7.32	44.98
Crimson Clover Hay	16.81	3.08	30.09	9.51	40.51
Cowpea Hay	18.59	2.46	22.51	8.40	48.14
Soja Bean Hay	17.36	5.86	25.14	8.12	43.52
Average	16.82	3.86	26.76	8.34	44.25
Sweet Potato Vine	12.48	4.86	18.22	8.73	55.71

In the above table it will be noted that the hays used for comparison are all leguminous; second, that they contain about 4% more protein on the average than the sweet potato vines, but that they also contain over 8% more fiber, which is not valuable as a feeding stuff. The sweet potato vines show a decidedly higher per cent of fat and nitrogen-free extract. While it cannot be concluded that the sweet potato vines are better than these hays, yet it can be said that stock relish these vines very much and that they contain high percentages of the fertilizing or feeding constituents.

As shown in various tables of compositions of different crops, the sweet potato contains a greater percentage of starch and sugars than the Irish potato. According to Dr. Groth, selected varieties in South Carolina yielded from 28 to 29% of starch; while the Irish potato, which is now extensively grown for commercial starch in Europe, especially in Germany and France, contains from 14 to 21% of starch. Now should the manufacture of starch from sweet potato assume any proportions, tests of the varieties of sweet potato would have to give us the necessary knowledge of the starch and sugars present, and of the comparative yields of the different varieties—which knowledge will enable us to begin systematic work, using the most promising varieties to breed for high yield of starch.

For the manufacture of starch, the following requisites are essential:—(a) A heavy yield; (b) High starch content and light or white color. For feeding purposes yield is of the utmost importance, content of dry matter being next in importance; for table purposes, maturity, size, shape, texture and color are important qualities. The first potatoes or any other first crops in the market bring good prices even though they are not entirely first class.

Although the value of sweet potato starch is not the subject of my work, its utility for laundry purposes is of such great local interest that I quote the following letter:

"Clemson College, S. C.,
April 17th, 1912."

"Mr. T. E. Keitt, *Chemist*,
Clemson College, S. C.

"Dear Sir:—

"I take pleasure in handing you herewith report on the test and demonstration made with sweet potato starch. I put the starch in question to the most rigid test consistent with the seventeen years of experience I have had in the use of starch in the laundry."

1. "The first thing that I discovered in the test was that it requires about one-fourth less of sweet potato starch than it does of the best brands of corn and wheat starch. I worked a batch of collars and cuffs with less than twelve ounces of sweet potato starch to a gallon of water and the result showed the work to be just as good as a batch of collars that I did with two of the best brands of corn and wheat starches, using sixteen ounces to the gallon of water."

2. "I found the sweet potato starch combined two of the foremost requirements of starch,—first, elasticity; and second, stiffness. It has a very smooth velvet-like finish and the garments starched with it do not rattle."

3. "It is certainly the easiest working starch that I have ever used. It will not corrode the ironing surface of steam or gas-heated machines or hand irons."

4. "It requires no wax, waxole or never break as do all other kinds of starch."

5. "Goods starched with sweet potato starch will stand up longer and give more comfort to the wearer than goods starched with other starches."

6. "The garments starched with sweet potato starch, which is free from acid, will not turn yellow with age or heat."

7. "In experimenting with mixtures of sweet potato starch and corn starch, and also with mixtures of sweet potato starch and wheat starch, I found that the mixtures of sweet potato starch and corn starch, gave much better results than the mixtures of sweet potato starch and wheat starch. I also found that a mixture consisting of one-third sweet potato starch and two-thirds corn starch gave the same results as the pure sweet potato starch."

"In conclusion, I wish to say that I do not think there is any starch on the market to-day that will equal sweet potato starch for all-round steam laundry and household use, and that it is just the starch that the wide-awake laundryman is looking for. I hope soon to see it put in reach of the trade."

"Very truly yours,
(Signed) J. E. ENGLAND."

For further information on the laundry use of sweet potato starch see Bulletin No. 136 of the South Carolina Experiment Station.

Identification of Variety

Method Used.—After having looked over the method of classifying an unknown sweet potato plant to its variety adopted by Mr. W. Robson from that of R. A. Price, horticulturist of the Texas Experiment Station in 1893, Farmers Bulletin No. 129, of the U. S. Dept. of Agriculture, published in the West Indian Bulletin, No. 4 (1912), pp. 521-526, and that adopted by Dr. Groth, in his thesis on "The Sweet Potato," the writer has followed the last method.

To give the reasons for my using Dr. Groth's key I can not do better than to quote what Dr. Groth says about it. Dr. Groth has the following reasons:

1. "It is a key and a classification combined. All varieties are determined by the same characters and can be readily compared, while in the ordinary key each variety is thrown out at an opportune moment by a character which may be common to many others already separated by some other character. One comes to associate that particular character with that variety, while in reality it depends entirely on the arbitrary arrangement of the key whether the character is used at all. Similarly there is very little attempt made in the arrangement of the ordinary key to keep together the varieties, resembling each other, while in this key they stand together naturally. For example, Bronze Spanish, as the name indicates, has a peculiarly colored tuber. In the ordinary key this character would very likely be used at an earlier stage to separate it. Black Spanish has a tuber which is similar to several others, and it would be hard to separate it by that character. Yet the two cannot be told apart in the field, unless one digs for the tubers."

2. "It can be used with incomplete specimens. If a certain character cannot be determined from the material on hand, the space reserved for it may be left blank, and the next character taken up. One is not continually before alternatives which may be at the time unanswerable. It is likely that the determination is possible even without that character."

3. "It is more convenient to the non-scientist. In the determination of all varieties the same process is gone through and once that process is learned by heart it need not be changed again for the determination of the next variety."

4. "It is flexible. The writer is certain that he has not studied all varieties existing. New varieties can be easily catalogued and inserted in the list by any one. In the ordinary key the advent of a variety necessarily causes confusion, as it not only could be wrongly determined itself, but would also interfere with the determination of other varieties which might agree with it in the critical characters. This would make an ordinary key useless, while this key provides for all. Should other characters be found which would aid in the determination, they could simply be entered under subsequent letter L, M, N, etc., without interfering in the least with the working of the key."

It will be much better for me to use Dr. Groth's key than to devise one for my own use, because by using his I make my varieties immediately comparable with those he studied. But in order that his formulae can be understood it is necessary to copy his explanation and directions for use. In

order to bring the known varieties together, as completely as is impossible, in one place, I also list his varieties. For the sake of easy comparison with Groth's varieties, I have also used feet and pounds in my descriptions.

The writer has observed one fact about the flowering habit of the varieties under his hands—that the varieties have different flowering habit. Some flower very thickly; others less thickly; others scarcely or not at all. So to the following key of Dr. Groth, the letter L will be added, on the flowering habit of the varieties.

Key Devised and Used by Dr. Groth

A.—Shape of the leaf.
1. Cut.
2. Round.
3. Long.
4. Broad.
5. Mixed (round and lobed).

B.—Size of the Leaf.
1. Small (less than 4 inches across).
2. Large (more than 4 inches across.)

C.—Length of Stem.
1. Long (more than 4 feet long).
2. Short (less than 4 feet long).

D.—Color of Stem.
1. Green (with or without brownish areas).
2. Green, with purple around the axils of the leaves.
3. Greenish-brown to purple.
4. Purple.

E.—Size of Stem.
1. Thin (less than 1-8 inch in diameter).
2. Thick (more than 1-8 inch in diameter, often 3-16 inch or more).

F.—Presence of Star.
1. Star present.
2. Star absent.

G.—Color of Lower Surface of Veins.
1. Veins purple.
2. Midrib pinkish in some old leaves.
3. Purple spot at the base of the midrib.
4. Veins all green.

H.—Arrangement of Hair on Upper Surface of Leaf.
1. Hair all over.
2. Chiefly on tip and along veins.
3. Hair absent.

I.—Outside Color of Tubers.
1. White.
2. Yellow, golden or bronze.
3. Yellow-red or pinkish.
4. Red or purple.

J.—Color of the Flesh of the Tubers.
1. White.
2. Cream-colored or yellowish-white.
3. Pinkish-white or pinkish-yellow.
4. Pink orange.
5. Marked with purple.

K.—Distinctness of Wood Elements in Tubers.
1. Distinct.
2. Blurred.
3. Not visible.

L.—Flowering Habit.
1. Flowers abundant.
2. Flowers fairly numerous.
3. Flowers very few.
4. Flowers none.

"Given a plant which was received under some unfamiliar name and it is to be determined whether it is an old variety appearing under a new name. The leaves are cut. That gives us A-1. Most of the *later* full grown leaves measure more than four inches across at their widest point, that is, from tip to tip of the most spreading lobes. That means B-2. The full-grown stems are shorter than four feet. So we put down C-2. As the stems are green with purple marks around the axils of the leaves, we have D-2. The full-grown stems measure 3-16 of an inch at their thickest point, which is expressed by E-2. The purple star is clear and the lower surface of the vein is purple, which gives us F-1 and G-1. As a few of the young leaves show a few scattered hairs on the midrib, and some of the old ones have no hair at all, we express that by H-2-3. The tubers we find

to be white outside and inside, which means I-1 and J-1. The bundles or wood elements are not visible on the freshly cut surface. That gives us K-3. Thus our formula runs, A1-B2-C2-D2-E2-F1-G1-H2-3-I1-J1-K3. Now if we refer to the alphabetical arrangement of the formulas which would be quoted below, we will find that it is the formula of Ticotea."

"ALPHABETICAL LIST OF FORMULAE."

A1 B2 C1 D1 E1 F2 G4 H1 I3 J3 K1	Belmont.
A1 B2 C1 D1 E1-2 F2 G1-3 H3 I2 J2 K3	Kala.
A1 B2 C1 D1 E1-2 F2 G4 H1 I2-3 J3 K1	Georgia.
A1 B2 C1 D2 E2 F1 G1 H2 I1 J1 K3	White Gild.
A1 B2 C1 D2 E2 F1 G1 H2 I2 J2 K3	John Burnet.
A1 B2 C1 D2 E2 F2 G3 H3 I3 J1 K3	Kamelo.
A1 B2 C1 D4 E1-2 F1 G1 H2-3 I3 J3 K3	Huamoa.
A1 B2 C1 D4 E2 F1 G1 H3 I4 J1 K3	Ihumai.
A1 B2 C2 D1 E2 F2 G3 H2 I4 J3 K3	Vincentonian.
A1 B2 C2 D2 E2 F1 G1 H2-3 I1 J1 K3	Ticotea.
*A1 B2 C D1 E F2 G4 H2 I3 J1 K3	Gros Gandia.
A2 B1 C2 D1 E1-2 F1 G1 H1 I1 J3 K3	Minnet.
A2 B1-2 C2 D1 E1-2 F2 G4 H1-2 I1 J1 K3	Vineless Beech.
A2 B2 C1 D1 E1-2 F2 G4 H1-2 I1 J1 K2-3	Caroline Lee.
A2 B2 C1 D1 E2 F2 G4 H2 I1 J2 K3	White Sealy.
A2 B2 C1 D2 E2 F1 G1 H1 I4 J2 K3	Trinidadian No. 1.
A2 B2 C2 D2 E2 F1 G1 H2 I1-2 J1 K1	Shanghai.
A2 B2 C2 D3 E2 F1 G1 H1 I4 J2 K3	Brass Cannon.
*A2 B C D4 E2 F1 G1 H1-2 I4 J1 K3	Muffard.
A3 B1 C1 D4 E1 F1 G1 H1 I2 J2 K3	Laiakona.
A3 B1 C1 D4 E1 F1 G1 H2 I4 J5 K3	Kapo.
A3 B1-2 C2 D4 E2 F1 G1 H2 I1 J1 K2	Thompson's Favorite.
*A3 B2 C1 D1 E1 F1 G1 H2 I4 J1 K	Indian Red.
A3 B2 C1 D2 E2 F1 G3 I1 J1 K1-2	Roosevelt.
A3 B2 C1 D2 E2 F1 G1 H3 I2 J2 K3	Pilipili.
A3 B2 C1 D2 E2 F1 G1 H3 I4 J1 K3	Kauaheahea.
A3 B2 C1 D4 E2 F1 G1 H2 I3-4 J2 K3	Yellow Reed.
A3 B2 C1 D4 E2 F1 G1 H2 I4 J5 K3	Black Spanish.
A3 B2 C1 D4 E2 F1 G1 H3 I2 J1 K3	Bronze Spanish.
A3 B2 C1 D4 E2 F1 G1 H3 I2 J3 K3	Pikonui.
A3 B2 C1 D4 E2 F1 G1 H3 I3 J2 K2	Key West.
*A3 B C D1 E2 F1 G1 H2 I2 J2 K3	Sulla.
*A3 B C D1 E2 F2 F4 H2 I3 J2 K2	Trinidadian No. 2.
*A3 B C D2 E F1 G1 H3 I4 J1 K3	Chazal.
A4 B1 C1 D3 E1-2 F1 G4 H2 I2 J2-3 K1	Yellow Colombia.
A4 B1 C1 D3 E1-2 F1 G4 H2-3 I1 J2 K1	White Colombia.
A4 B1 C1 D3 E1-2 F2 G2 H2 I1-2 J2 K2	Southern Queen, weak type
A4 B1-2 C2 D2 E2 F1 G1 H1 I3 J1 K2	Red Seally.
A4 B2 C1 D3 E2 F2 G2 H2 I1-2 J2 K2	Southern Queen, strong type.
*A4 B2 C2 D2 E2 F1 G1 H1 I2 J K	Florida.
A4 B2 C2 D4 E2 F1 G1 H3 I4 J1 K3	Halonaipu.
A4 B2 C2 D4 E2 F2 G2-3 H3 I2 J3 K3	Pu.
*A4 B C1 D2 E1 F1 G1 H3 I4 J5 K3	Violet Rouge.
*A4 B C D2 E F1 J1 H3 I3 J5 K3	Violet Blanche.
A3-4 B1 C1 E1 F2 G3 H1 I3-4 J2 K2	Peabody.
A3-4 B1-2 C1 D1 E1 F2 G3 H1 I2 J2-3 K1	Carolina, extra early.
A3-4 B2 C1 D1 E2 F2 G4 H1 I2 J3 K1	Norton.
A4-3 B1 C1 D1 E1 F2 G4 H1 I3 J4 K2	Pumpkin.
*A4 B2 C D1 E2 F2 G4 H1 I3 J3 K3	Fire Brass.
A5 B1 C1 D1 E1 F2 G3 H1 I2 J2 K2	Up River.
A5 B1 C1 D1 E1 F2 G3 H1 I2 J3 K1	Yellow Jersey.
A5 B1 C1 D1 E1 F2 G3 H1-2 I4 J2 K2	Red Jersey.
A5 B1-2 C1 D1 E1 F2 G3 H1 I2 K2	Pepper's Choice.
A5 B1-2 C1 D3 E1-2 F1 G1 H (1-2) I1-2 J1-2 K1	Yellow Strassburger.
A5 B1-2 C1 D4 E1-2 F1 G1 H2 I1-2 J2 K2	Alabama.
A5 B1-2 C1 D4 E1-2 F1 G1 H2 I4 J2 K2-3	Red Nausemond.
A5 B1-2 C1 D4 E1-2 F2 G3 H1 I4 J3 K1	Van Nis Red.
A5 B2 C1 D4 E2 F1 G1 H2 I1-2 J2 K2	Early General Grant.
A5 B2 C2 D1 E2 F1 G1 H1 I3 J3 K2	Nancy Hall.
*A5 B C D2 E F1 G1 H3 I2 J2 K3	Yellow Mauritius.

*Plants were too young to be fully determined, so the full formula is not given.

A. (a) By cut leaves Dr. Groth defines all those in which the projecting lobes constitute almost the entire leaf surface, so that little remains when all the lobes are cut off at their bases by cuts perpendicular to their median lines. (b) By round leaf is meant a heart-shaped entire leaf. (c) In all well formed, full-grown leaves of these varieties the length of the large central lobe, as measured along the median line from the base of the lobe to its tip exceeds the greatest breadth of the same lobe. (d) The greatest breadth i. e., the base of the central lobe exceeds its length from the base to the tip. (e) All varieties which normally have well developed full grown "round" leaves, as well as "long" or "broad," have been classed as "mixed leaves."

Since the young plant of sweet potato does not show its characteristic leaves until it is about two months old, plants of different age should not be compared; adult plants should be used. It must also be kept in mind that according to Dr. Groth the sweet potato plant is apt to vary under different climatic conditions, since all varieties of sweet potato are supposed to have originated from the same plant. The same is also true of other plants, as for example, tobacco and sweet corn. The tobacco plant, according to Prof. C. F. Baker, is one of the most sensitive and most responsive to environment of all cultivated plants. Sweet corn, Dr. Groth says, growing six feet high in the Northern States and having the ear about two and one-half to three feet from the ground, will scarcely grow four feet tall when planted in Western Texas and make the ears right on the ground in the first season. Dr. Groth goes on to say, that such behavior may be due to one or two things, "Either the variety will not grow under the new conditions or it needs to be acclimated."

The following will amply demonstrate the different behavior of the sweet potato plant as evidenced by the descriptions in different sections of the United States.

Mr. Price describes the Southern Queen as follows:—

"Round-leaved, foliage pale green, sometimes prominently notched on one side, vines vigorous, roots profuse, length eight feet, much grown in the South, tubers obtuse, medium size, white. Reliable. Soft, damp, late."

Maryland Bulletin 33. "The Southern queen is a good yielder and a very handsome and salable potato."

Iowa Bulletin 47. "Southern Queen, medium runner, leaves large, dense mat of foliage, tubers large, fairly smooth, incline to run to roots. Skin greenish-brownish, rough; flesh yellow, very wet, coarse, not very sweet, nor pleasant. Very popular in the South."

North Carolina Bulletin 74. "Southern Queen, very productive, good keeper, heading the list in keeping qualities."

Arkansas Report 1890. "Southern Queen, heavy growth of vines, tubers large and smooth. An early variety."

Georgia Bulletin 25. "Southern Queen, leaves shouldered. Foliage deep green. Vines quite vigorous. Tuber quite large, both round and ovoid. Skin white, flesh grayish white or grayish yellow, quality very poor, stringy, coarse, fibrous and tasteless. Rather early and productive."

Louisiana Bull. 13. "Southern Queen. Most popular in the South, excepting the Georgia and Sugar Yam. Tubers sound and mealy. Vines very strong. Good producer. Improved in flavor by storage."

Louisiana Bull. 21. "Southern Queen. Large, round, light yellow skin, and meat fair quality; very early and popular; a good potato."

Louisiana Bull. 30. "Southern Queen. White, rather hard, dry, late. Strong grower. Vines large and green. Leaves large, broad, rather blunty pointed and have side points. Fresh nearly white and rather dry. A very popular variety, and good producer."

Louisiana Bull. 36, p. 1266. "Southern Queen is recommended for both. quality and quantity."

Louisiana Bull. 52. "Southern Queen. One of the most productive varieties (720 bushels per acre in the last experiment), but not an excellent table variety. Suggest an enormous amount of hog and stock food, and should be grown largely for this purpose."

Fitz (Sweet Potato Culture, p. 9). Southern Queen is the earliest of all sweet potatoes. In eating condition (near Baltimore) by the middle of July. Root very large, light color, good keeper, vines vigorous, leaves large. Good quality."

Summing up all that has been said above about the Southern Queen, one of the best known sweet potatoes in the United States, it is variously characterized as round leaved and shouldered, foliage pale green and dark green, vine very vigorous and medium; tubers obtuse, round and inclined to run to roots, medium sized and large, smooth, and rough; skin white, greenish brown, and light yellow; flesh yellow, grayish white, grayish yellow, light yellow, soft and hard, damp, very wet, mealy and dry; quality poor, fair, recommendable, a good potato, good hog and stock food, flavor coarse, fibrous, tasteless, yet a very popular table variety in the South; late, rather early, very early and earliest of all potatoes.

The writer has quoted the above different statements concerning the Southern Queen in order to show how variable the sweet potato plant is under different climatic conditions, so that if any one happens to classify some sweet potato plants which are of the same kinds as the ones the writer is working on, in a different locality, and finds that his description do not agree with the writer's, he can simply refer, for the explanation, to the above different statements on the Southern Queen.

Description of the Varieties

These varieties were mostly obtained from Ligao, Albay Province, and are given their local names. Two of the varieties came from Manila, and are known by the descriptive names "Manila Puti" and "Manila Pula". Three of these, which are Montivedeo, Samar Big Yellow and Beattie Camote are from the College of Agriculture and from Dr. Foxworthy, respectively.

Each of these varieties has its own formula as determined by the writer according to Dr. Groth's key, which formula will enable one to distinguish it from the other varieties.

Varieties

1. Amorosa.

Formula.—A3-4 B2 C1 D3 E2 F2 G3 H2-3 I1 J1 K2 L2.

Stem about 12 feet long; diameter from 3-16 to ¼ of an inch; young stem from grayish to grayish-yellow; old stem light purplish, hairs present chiefly near the axils of the leaves, and gradually losing from the base of the stem to the tip; leaves are broad and long, young leaf yellowish green; old leaf green; mature average leaf 5¼ to five and 5-16 inches across, and five and ¼ to six and ½ inches long, i. e., from the tip to the junction of the petiole and leaf; veins green, with purplish spot at the base of the midrib, and the latter light-pinkish; hairs present in young and absent in old leaves; star absent; long average petiole measures from five and one-half to six and five-sixteenths

inches; hair present; vegetation vigorous and vines vigorous; matures early, tubers variously shaped, as roundish, long, crooked and big, somewhat attacked by disease; skin whitish; flesh white; latex abundant; cooked tubers:—color changes from whitish to grayish-white, smells fine and tastes sweet; sticky; almost free from fiber; meat grayish white in the middle and grayish around. Flowers less thick.

2. Beriberi.

Formula.—A4 B2 C1 D1 E1-2 F2 G4 H3 I2 J3 L1.

Stem about 7 feet long; diameter from 1-8 to 3-16 of an inch; young stem from grayish to brownish and hairless; old stem almost of the same color as the young and hairless; hairs present in some stems but absent in others; leaves peculiarly lobed, resembling the teeth of the big (cross-cut) saw, and broad; mature average large leaf 4 and one-fourth to 5 and five-eighths inches across, and 4 and 3-8 to 4 and 11-16 inches long; young leaf from brownish to purplish; old leaf light-green; veins all green; hairs absent; star absent; long average petiole measures from 4 and ¾ to 4 and 3-8 inches; few hairs present; vegetation somewhat vigorous; matures early; tubers are somewhat uniform in shape, being roundish and long, of medium size, smooth and not very susceptible to disease; good yielder; skin slightly pinkish-yellow; flesh pinkish-yellow or orange and yellowish outside; latex little. Cooked tuber:—color changes from yellowish-white to pinkish; smells characteristic, i. e., different from the rest; tastes somewhat sweet and free from fiber; meat somewhat sticky and pinkish-yellow. Flowers many.

3. Beattie Camote.

Formula.—A5 B1-2 C1 D3 F1-2 G3 H2-3 I2 J2 K3 L3.

Stem about 7 feet long; diameter from 1-8 to 3-16 of an inch; young stem grayish-yellow or greenish-brown, with very scanty hairs; old stem light purple on upper surface and purple underneath; hairs present, especially at or near the junction of the stem and the base of the petiole; leaves variable, some are lobed and some are round or heart-shaped; mature average large leaf 4 and 3-16 inches across, and 4 and ½ inches long; young leaf greenish-yellow with purplish margin; old leaf green; veins green or purplish; base of the midrib purplish, midrib pinkish and greenish near or at the tip; hairs present especially at the tip and along the veins; star present in some but absent in others; average long petiole measures 5 and ½ inches; hairs absent; vegetation not so vigorous; matures early; tubers more uniform and almost all roundish, medium to big, almost free from disease; skin yellowish; flesh cream or yellowish-white; latex abundant. Cooked tubers:—color changes from yellowish-white to grayish-white; smell fine and sweet, sticky; free from fiber, meat yellowish, extra best for table purposes. Flowers very few.

4. Bingló.

Formula.—A5 B2 C1 D3 E2 F1 G1 H2-3 I4 J2 K3 L3.

Stem about 16 feet long; diameter from 3-16 to ¼ of an inch; young stem grayish or greenish; old stem purplish, hairs abundant; leaves from entire and long to somewhat lobed; mature average leaf 5 and ¼ to 5 and 11-16 inches across, and 5 and ¼ to 5 and ½ inches long; young leaf grayish or yellowish green, with purplish margin; old leaf green; hairs present on the midrib of some young leaves but absent in others, star present; mature average long petiole measures from 6 to 7 and 1-8 inches; hair present; vegetation very

vigorous; vines very vigorous; matures somewhat early; tubers variable in shape, long, short, and crooked, medium size, skin red to purplish; flesh cream-like, latex little; tubers attacked by disease and with peculiar smell; cooked tubers:—color changes from red to dark red; odor good, soft, savory, sweet, very stringy outside but not in the middle. One of the favorites of Ligao; meat grayish-yellow, flowers very few.

5. Bocoboco Red.

Formula.—A2 B1-2 C1 D2 E2 F1 G3 H3 I4 J2 K3 L3.

Stem about 7 and ½ feet long; diameter from 3-16 to ¼ of an inch; young stem grayish with some purple areas around the axils of the leaves; hairs present; leaves heart-shaped; young leaf purple; old one green; mature average large leaf 4 inches across, and 3 and 13-16 inches long; veins light purplish; midrib pinkish and purplish at the base; hairs absent; star present; mature average long petiole measures 3 and 7-8 inches; hairs present; vegetation quite vigorous; matures extra early; tubers variously shaped being long, crooked and big, and somewhat free from disease; skin reddish; flesh cream color; latex scanty. Cooked tubers: color changes from reddish to purplish; meat whitish in the middle and cream outside; odor good; soft; flavor good, sweet and with very little fiber; good for table purposes. Flowers few.

6. Bocoboco White

Formula.—A3-4 B2 C1 D1 E2 F2 G3 H2 I1 J1 K2 L3.

Stem about 9 feet long; diameter from ¼ to 5-16 of an inch; young stem practically of the same color as the old stem which is greenish-brown; hairs abundant; leaves long and broad; mature average large leaf 5 and 3-16 to 5 and ¾ inches across, and 5 and ¼ to 5 and 11-16 inches long; young leaf light purplish; old leaf green; veins pinkish-green, light purplish at the base of the midrib; hairs present along the upper surface of the midrib and at the tip; star absent; mature average long petiole measures from 6 and ¾ to 9 and ¼ inches; hairs present; vegetation very vigorous; vines vigorous; matures early; tubers variously shaped, being roundish and somewhat long, with longitudinal groove in some; susceptible to disease; skin white; flesh white; latex scanty; cooked tubers:—no change of color; meat grayish, smells good, soft and of good flavor; sweet but somewhat stringy. Flowers few.

7. Bocoboco Pinkish-White

Formula.—A3-4 B2 C1 D3 E2 F1-2 G3 H3 I2 J1 K3 L3.

Stem about 14 feet long; diameter 3-16 of an inch; young stem grayish to brownish; hairs abundant; old stem from light green to pinkish; hairs present; leaves long and broad; mature average large leaf 4 and ¾ to 5 and 3-16 inches long, and from 4 and ¾ to 4 and 15-16 inches across; young leaf purplish to purple; old leaf green; veins light pinkish and light purplish at the base of the midrib; hairs absent; star absent or present; mature average long petiole measures from 6 to 6 and 5-16 inches; hairs present; vegetation not vigorous; matures early and somewhat susceptible to disease; tubers variously shaped, being round, long and big; latex scanty; skin pinkish-white; meat grayish-white; cooked tubers:—no change of color; meat grayish-white, with white in the middle; smells good, good flavor and sweet; somewhat sticky and not stringy; a good table variety. Flowers few.

8. Bulaqueña

Formula.—A3-4 B2 C1 D3 E2 F2 G2 H2 I1 J1 K1 L2.

Stem about 8 feet long; diameter about ¼ inch; young stem of practically the same color as the old stem, which is purplish-brown; hairs present; leaves long and broad; mature average large leaf 5½ to 6 inches across, and 4¾ to 4 7-8 inches long; young leaf purplish, especially the midrib; hairs present on some and absent on others; star absent; mature average long petiole measures 5 and ½ to 5 and 7-8 inches; hairs present; vegetation vigorous; vine vigorous; matures somewhat early; tuber small, roundish and variously shaped; skin white; flesh white; latex abundant; cooked tubers:—color changes from white to yellowish; meat whitish in the middle, grayish outside; few fibers, smells good; flavor fine, sweet but not so sticky; flowers fairly numerous.

9. Caniang

Formula.—A4-3 B2 C1 D1 E2 F1 G4 H3 I1 J1 K3 L3.

Stem about 8 feet long; diameter about ¼ inch; young stem light green; old stem green; hairs present; leaves broad and long; young leaf yellowish-green; old leaf green; star absent; hairs absent; mature average large leaf 5 and 7-8 to 6 and ½ inches across, and 5 and ½ to 5 and 13-16 inches long; veins green or whitish; mature average long petiole measures from 6 and 1-8 to 8 inches; hairs present; vegetation very vigorous; matures early; tubers variously shaped, being long, roundish and big; somewhat attacked by disease; a very good yielder; skin white; flesh white; latex abundant; cooked tubers:—color changes from whitish to grayish white; meat whitish in the middle and grayish outside; smells fine; tastes good and sweet; sticky and almost free from disease, and stringless; flowers few.

10. Gaire

Formula.—A4 B2 C1 D3 E2 F1-2 G2 H2 I1 J1 K1 L2.

Stem about 18 feet long; diameter 3-16 of an inch; young stem from grayish to purplish; old stem purplish—and brownish-green; hairs present; leaves broad and lobed; mature average large leaf 5 and 1-8 to 6 and ¾ inches across, and 3 and ¾ to 5 and 3-8 inches long; young leaf yellowish-green; old leaf green; hairs present; star absent in some but present in others; mature average long petiole measures 5 and 1-16 to 5 and ½ inches; hairs present; vegetation not vigorous; matures very late; tubers are very long and very slender or root-like; skin white and flesh white; cooked tubers:—no tubers were cooked as they were all very small and slender, and they are very fibrous; a very undesirable variety for table purposes. Flowers somewhat abundant.

11. Iningcanto

Formula.—A3-4 B2 C1 D1 E2 F1-2 G3 H3 I4 J2 K3 L3.

Stem about 7 feet long; diameter ¼ of an inch; young stem greenish-brown; old stem almost the same as the young; hairs present almost all over; leaves long and broad; mature average large leaf 4 and 5-8 to 5 and ½ inches across, and 5 and 1-16 to 5 and 3-16 inches long; young leaf purplish; old leaf green; hairs absent; star present in some and absent in others; veins green; with purplish spot at the base of the midrib; mature average large petiole measures 4 and ¾ to 8 and ¼ inches; hairs present but very scarce; vegetation vigorous; matures early; tubers variously shaped, being roundish, long and big; almost free from disease; good yielder; skin pinkish-red; flesh cream or yellowish; latex abundant; cooked tubers:—color changes from reddish to pale red; meat yellowish in the

middle, grayish outside; smells fine; tastes somewhat sweet; somewhat sticky, free from fiber. Flowers few.

12. Magallanes

Formula.—A4-3 B1-2 C1 D4 E2 F1 G1 H1 I2 J1 K3 L3.

Stem about 10 feet long; diameter 3-16 of an inch; young stem light purple, old stem purple; hairs present; leaves broad and long; mature average large leaf 4 and ¼ to 5 and 5-16 inches across, and 4 and 1-8 to 5 and 7-8 inches long; young leaf greenish yellow with purplish margin, old leaf green; hairs present almost all over; star present; mature average long petiole measures 6 and 5-16 to 7 and ½ inches; hairs present; vegetation not vigorous; matures early; tubers of medium size, very long in proportion to the diameter; almost free from disease; skin yellow or golden; flesh white; latex abundant; cooked tubers:—no change of color; meat cream in the middle and grayish outside; smell agreeable; flavor good; sweet and sticky; few fibers; flowers few.

13. Manila Pula

Formula.—A1 B1-2 C1 D3 E2 F2 G4 H2-3 I4 J2 K3 L3.

Stem about 12 feet long; diameter about 3-16 of an inch; young stem grayish to brownish green; old stem brownish on upper surface and purplish beneath; hairs present; leaves cut; mature average large leaf 4 and ½ to 5 and 13-16 inches across, and 4 and ¼ to 4 and 3-8 inches long; young leaf yellowish-green with dark brown margin; old leaf green; veins all green or whitish; hairs sparsely scattered on the upper surface of the midrib; star absent; mature average long petiole measures 4 and ¾ to 5 and 5-16 inches; hairs present, sparsely scattered; vegetation vigorous; matures extra early; tubers variously shaped, being long, roundish and big; almost free from disease; skin reddish; flesh cream color; latex abundant; cooked tubers:—color changes from reddish to pinkish; meat yellowish; smell agreeable; flavor fine; sweet and not stringy; flowers few; good table variety.

14. Manila Puti or Yellowish White

Formula.—A4 B1 C1 D3 E1-2 F1 G1 H2 I2 J2 K2 L3.

Stem about 12 feet long; diameter about 1-8 of an inch; young stem grayish with purplish areas; old stem purplish; hairs present; especially around the axils of the petioles; leaves broad and somewhat lobed; mature average large leaf 3 and ½ to 3 and 15-16 inches across, and 3 and ¼ to 3 and 7-8 inches long; star present; hairs present especially along veins and at the tip; young leaf purple; old one green; veins purplish; mature average long petiole measures 4 to 4 and 7-8 inches; hairs present; vegetation not vigorous; matures early; tubers variously shaped, being long and roundish and of medium size; not susceptible to disease; skin yellowish or golden; flesh cream color; latex abundant; cooked tubers:—no change of color; meat light yellowish; smell pleasant; flavor good; sweet and not stringy. Flowers few.

15. Maragadan. (Maraganda)

Formula.—A4 B2 C1 D3 E1-2 F1 G1 H2-3 I4 J4 K3 L3.

Stem about 11 feet long; diameter about 3-16 of an inch; young stem purplish in some and brownish in others; old stem brownish; hairs present in young, but practically not on old stem; leaves broad; mature average large leaf 4 and 7-8 to 5 and 1-8 inches across and 4 and ½ to 5 and 3-8 inches long; young leaf purple; old one green; veins purplish; hairs very few, scattered here and there on the upper surface

of the midrib; star present; mature average long petiole measures 4 and 1-16 to 5 and ½ inches; hairs present; vegetation vigorous; matures early; tubers variously shaped, being long, crooked and roundish, big and small; almost free from disease; skin pinkish; flesh purplish in the middle with a whitish band outside and a purplish band surrounding the white band; latex scanty; cooked tubers:—color changes from reddish to brownish red; smell pleasant; taste somewhat sweet and sticky; meat violet-purple in the middle and grayish around, non-fibrous; flowers few; good for fancy colored "dulce."

16. Montevideo

Formula.—A1 B2 C1 D1 E2 F2 G2-4 H3 I3 J2 K1 L3.

Stem about 9 feet long; diameter about 3-16 of an inch; young stem from green to light brownish-green; old stem greenish with brownish spots or areas; hairs absent; veins green; midrib pinkish in some; hairs absent; star absent; mature average large leaf 4 and ¼ to 6 inches across, and 3 and ½ to 4 and 7-8 inches long; leaves cut; mature average long petiole measures 5 to 5 and ½ inches; hairs absent; vegetation not vigorous; matures extra early; tubers big and variously shaped, being roundish, long and with many longitudinal groves; skin pinkish; flesh cream-color; latex abundant; cooked tubers:—no change of color; meat yellowish, less sweet and sticky; non-fibrous; smell and flavor good; flowers few.

17. Quinalabit

Formula.—A3 B1-2 C1 D1 E2 F2 G4 H3 I4 J1 K3 L3.

Stem about 6 feet long; diameter about 3-16 of an inch; young stem very much like the old stem, which is grayish; hairs present; leaves, some are long; mature average large leaf 4 and 5-6 inches long, and 4 and ½ inches across; young leaf yellowish-green with purplish margin; veins all green; hairs practically absent; star absent; mature average long petiole measures 4 and 3-16 inches; hairs present; vegetation not vigorous; matures somewhat late; tubers very long in proportion to diameter, with many fine roots on the skin; skin red; flesh whitish, almost free from disease; latex abundant; cooked tubers:—no change of color; meat somewhat sweet and fibrous; flowers few.

18. Samar Big Yellow

Formula.—A5 B1-2 C1 D3 E1-2 F1 G3 H1 I3 J4 K2 L1.

Stem about 9 feet long; diameter about 3-16 of an inch; young stem pinkish in some and brownish in others; hairs present all over, very abundant; leaves lobed and round or heart-shaped; mature average large leaf 4 and ¾ to 5 and ¼ inches across, and 4 and ½ to 5 and 5-8 inches long; young leaf purple; old leaf green; veins green or whitish; midrib pinkish and purplish at the base; hairs all over; star present, but not very distinct; mature average long petiole measures 5 and 9-16 to 5 and 15-16 inches, hairs very abundant; vegetation not so vigorous; matures rather late; tubers of somewhat uniform shape, roundish to long; skin pinkish-yellow; flesh purplish, somewhat susceptible to disease; latex abundant; cooked tubers:—no change of color; meat dark pinkish or purple outside and violet at the middle, sweet and non-fibrous; smell fine; flavor especially good (pronounced by most students who have tasted it to be the best in taste); flowers many.

19. Sumao

Formula.—A3 B1 C2 D4 E2 F1-2 G2 H2 I4 J1 K1 L2.

Stem less than four feet long; diameter about ¼ of an inch; young stem prac-

tically of the same color as the old stem which is purplish; hairs present; leaves long; mature average large leaf 3 and 15-16 to 4 and ½ across, and 4 and ¼ to 4 and 5-8 inches long; young leaf purplish; old leaf green; star present in some and absent in others; hairs present, especially on tip and along veins; mature average long petiole measures 4 and 9-16 to 5 and 15-16 inches; hairs present; vegetation not vigorous; matures very late; tubers very small and of various shapes; skin reddish; flesh whitish; attacked by disease; very undesirable variety; latex abundant.

20. Ucab

Formula.—A5 B2 C1 D3 E2 F1-2 G2 H3 I1 J1 K3 L2.

Stem about 6 feet long; diameter about ¼ of an inch; young stem practically of the same color as the old, which is purplish; hairs present; leaves are of mixed shape; mature average large leaf 4 and 15-16 inches across, and 5 and 7-16 inches long; young leaf greenish-yellow with purplish margin; old leaf green, midrib in some old leaves pinkish, in others with a purplish spot at the base of the midrib; hairs practically absent; few hairs scattered here and there, near the tip; star present in some and absent in others; mature average long petiole measures 5 and 5-16 inches; hairs present; vegetation vigorous; matures early; tubers variously shaped, being roundish, long and big; skin white, flesh white almost free from disease; latex abundant; cooked tubers, see Amorosa; flowers, fairly many.

Cultural Treatment of the Different Varieties

With the object of finding out the effect of ridge and level cultures upon the yield of the sweet potato plant the writer has conducted this experiment. It is also the writer's aim to determine the comparative yield of the different varieties treated under the same cultural method.

Preparation of the Soil.—The greater part of the area used was previously planted with sweet potato; a smaller area was occupied by different weeds and a third small area was occupied by orchard trees and ornamentals, mostly papayas and *Codiaeum variegatum*. These three areas are so near to each other that they form one general area. The entire area was first thoroughly plowed and harrowed. Then, it was divided into plots 4 meters by 12 and ½ meters, or 50 sq. m., which is 1-200 of a hectare. Each plot was planted with one variety of sweet potato, except that in some cases, because of the lack of cuttings, two varieties were planted in one plot.

Preparation of the Ridges.—In the South Carolina Experiment Station Bulletin No. 146, April, 1909, Mr. Sternes states, as a result of two years' work, that the best distance at which to plant sweet potatoes is 18 inches in the row and 3-4 feet between rows. This distance was used in my ridge culture; each plot was divided into four big ridges. The ridges were prepared with ordinary garden hoes.

Three of the plots were made level for comparison, and each was divided into six length-wise rows; the distance of the rows from each other was 24 inches or 61 cms. (Farmers' Bulletin 324—Sweet Potato—by W. R. Beattie). The plants were planted at the same distance in the row.

All of the varieties were not planted at the same time, but the interval of time was not long enough to affect the plant in any way. Two cuttings were planted in each hill. At this rate 208 cuttings can be planted in the ridge plot and 240 cuttings in the level plot.

The planting was done on the following dates. The numbers show how many cuttings lived.

November 29th, 1912

(1)	Bingló	66
(2)	Bulaqueña	53
(3)	Bocoboco Pinkish-White	66
(4)	Bocoboco Red	35
(5)	Bocoboco White	71
(6)	Manila Pula	184
(7)	Manila Puti	197
(8)	Samar Big Yellow	204
(9)	Montevideo	190

November 30th, 1912

(10)	Amorosa	112
(11)	Gaire	73
(12)	Magallanes	160

December 7th, 1912

(13)	Iningcanto	143
(14)	Caniang	165

December 8th, 1912

(15)	Sumao	77
(16)	Beriberi	60
(17)	Maragadan	35
(18)	Ucab	50
(19)	Quinalabit	86

December 9th, 1912

(20)	Beattie Camote	158

The Following Were Planted in Level Culture December 11th, 1912

(1)	Beattie Camote	238
(2)	Manila Pula	212
(3)	Samar Big Yellow	239

Cultivation

Cultivation was begun at the appearance of the first weeds. This was done by ordinary garden hoes, as it was not feasible to use any other implements. The vines were not permitted to take root. The second cultivation was not as hard as the first, as few weeds grew then. By the third cultivation the vines nearly covered the entire surface, so that it was not necessary or practicable to disturb the plants any longer.

It must be further considered that these varieties were not planted at the proper season, which may have affected the production and character of the tubers. The measurements of the leaves and the other items making up the description of the varieties may also have been more or less modified by the unfavorable season. Moreover, the soil on which these varieties were grown is pronouncedly poor in nitrogen, which is the foliage-forming element; this may have had a very important influence upon the measurements given in the description.

In the Ph lippines, the planting time of sweet potato, as far as the writer's experience on this matter extends, begins in March, or April, or sometimes in May.

The Harvest

The following varieties were harvested March 17th, 1913, three months and eighteen days after the planting of the cuttings:—Bingló, Bulaqueña, Bocoboco Pinkish-White, Bocoboco White, Bocoboco Red, Manila Pula, Manila Puti, Samar Big Yellow, Montevideo. March 18th, Amorosa, Gaire, and Magallanes were harvested; March 23rd, Iningcanto and Caniang; March 24th, Sumao, Beriberi, Maragadan, Ucab, Guinalabit; March 25th, Beattie, and also the three varieties planted in level, Manila Pula, Samar Big Yellow, and Beattie.

From the above it may be seen that the period of growth in all varieties was almost the same; the difference was one day in some, two days in others and four days in the last three named varieties. This difference is so small that it would not appreciably affect the development of the tubers.

TABLE SHOWING THE RESULTS OF THE EXPERIMENT AND THE COMPUTED RESULTS PER HECTARE

Varieties.	Date of planting.	Date of harvesting.	Number of cuttings planted.	Number of Marketable Tubers.	Number of Unmarketable Tubers.	Wt. of Marketable Tubers.	Wt. of Unmarketable Tubers.	Total Wt. of Tubers.	Ave. Wt. of Marketable Tubers.	Ave. Wt. of Unmarketable Tubers.	Ave. Wt. Marketable and Unmarketable Tubers.	Computed Number of Cuttings per Hectare.	Computed Number of Marketable Tubers per Ha.	Computed Number of Unmarketable Tubers per Ha.	Computed Wt. of Marketable Tubers per Ha.	Computed Wt. of Unmarketable Tubers per Ha.
						Kilos.	Kilos.	Kilos.	Grams.	Grams.	Grams.				Kilos.	Kilos.
Bingló	11-29-12	3-17-13	66	53	130	5.55	4.55	10.10	104.71	35.00	69.85	48,000	38,544	98,080	4008.57	3432.80
Bulaqueña	11-29-12	3-17-13	53	25	58	1.55	1.55	3.10	54.00	26.72	40.31	48,000	22,560	52,320	1398.72	1360.32
Bocoboco Pinkish White	11-29-12	3-17-13	66	47	110	3.75	3.75	7.50	79.78	33.18	56.48	48,000	34,080	79,680	2692.32	2709.12
Bocoboco White	11-29-12	3-17-13	71	44	88	4 55	3.55	8.10	103.41	40.34	71 87	48,000	29,760	59,520	3065.28	2398 65
Bocoboco Red	11-29-12	3-17-13	40	91	94	15.15	4.95	20.10	166.48	52.69	109.56	48,000	108,960	112,800	18087.36	5865.60
Manila Red	11-29-12	3-17-13	184	210	230	29.35	5.15	34.50	139.76	22.39	81.07	48,000	54,720	60,000	7606.08	1320.00
Manila White	11-29-12	3-17-13	197	360	220	32.35	3.55	35.90	89 86	16.13	52 99	48,000	87,360	53,280	7775.04	586.08
Samar Big Yellow	11-29-12	3-17-13	204	523	408	24.55	5.95	30.50	46.94	14.58	30.76	48,000	122,880	96,000	5652.48	1152 00
Montevideo	11-29-12	3-17-13	190	289	180	38.95	5.35	44.30	134.77	29.72	82.24	48,000	72,960	45,120	9786.64	1308.48
Amorosa	11-30-12	3-18-13	112	83	51	13.35	0.95	14.30	160.84	18.62	89.73	48,000	35,520	21,600	5683.20	388.80
Gaire	11-30-12	3-18-13	73	0	120	0	1.35	1.35	0	11.25	5.62	48,000		78,720		865.92
Magallanes	11-30-12	3-18-13	160	244	178	23.75	4.75	28.50	97.33	26.68	62.00	48,000	72,960	53,230	7076.12	1385.28
Iningcanto	12- 7-12	3-23-13	143	380	182	40 95	5.55	46.50	107.76	30.48	69.12	48,000	127,200	60,960	13699.44	1828.80
Caniang	12- 7-12	3-23-13	163	460	374	42.15	11.35	53.50	91.62	30.34	60.98	48,000	134,400	109,920	12311.05	3330.58
Sumao	12- 8-12	3-24-13	77	0	72	0	0.95	0.95	0.0	13.19	6.59	48,000		44,640		1428.48
Beriberi	12- 8-13	3-24-13	60	88	64	8.55	1.55	10.10	97.16	24.22	60.69	48,000	70,080	50,850	6797.76	1220.40
Maragadan	12- 8-13	3-24-13	35	71	40	8.35	0.95	9.30	117.60	23.75	70.65	48,000	96,960	54,720	11442.28	1313.28
Ucab	12- 8-13	3-24-13	50	34		3.85	....	3.85	77.00		38.50	48,000	32,640		2513.28	
Quinalabit	12- 8-13	3-24-13	86	49	52	4.15	1.35	5.50	84.60	25.96	55.32	48,000	27,360	28,992	2326.60	753.79
Beattie Camote	12- 9-13	3-25-13	158	219	198	16.75	5.15	21.90	76.48	26.00	51.24	48,000	66,440	60,000	5044.44	1560.00

Average yield of the 20 varieties. 330.88 bushels per hectare.

The soil was so dry that there was no need of washing the tubers; however, they were wiped clean before weighing. The tubers were divided into two lots, marketable and unmarketable. Marketable include those which, in my opinion, can be marketed. Unmarketable includes those which are diseased and those that are very small, which may be utilized either for stock feeding or for propagation.

The opposite table shows the results of the experiment. The computed yield per hectare is shown in the lower part of the table. Being computed from results on small areas these figures are not of much value except for comparison of varieties, but are valid on this point.

Bull. No. 165, June, 1912, South Carolina Experiment Station, p. 7, states the different yields, in bushels per acre, of several varieties. The following table gives these figures, and the computed yield per hectare:

Varieties	*Bu. per Acre*	*Bu. per Hectare.*
Nancy Hall	270.0	666.90
Polo	281.0	694.07
Southern Queen	416.0	1027.52
White Spanish	141.0	348.27
General Grant	191.0	471.71
Brazilian	450.0	1111.50
Arkansas Beauty	158.0	390.00
Tennessee Notchleaf	281.0	694.07
Yellow Nancemond	214.2	528.58
Purple Yam	180.0	444.60
Pumpkin Early Yellow Yam	270.0	666.90
Shanghai Yam	174.0	429.00
Vineland Bunch Yam	141.0	348.27
Fulleton Yellow Yam	326.0	805.22
Average	250.0	617.50

This table shows that in South Carolina, as here, the different varieties are unequal in yield. The yield per hectare of the varieties, as a whole, shown in this table, is very much higher than the computed result arrived at by the writer. But the following table, taken from the U. S. Twelfth Census Report, showing yields of all varieties for whole states, has figures which more or less conform to the computed results obtained by the writer.

States	*Bushels*	*Acres*	*Per Acre (Bu.)*
North Carolina	5,781,587	68,730	84
Georgia	5,081,678	70,620	72
Virginia	4,470,602	40,681	110
Alabama	3,457,386		
South Carolina	3,369,957	48,831	69
Texas	3,299,135	43,561	76
Mississippi	2,817,386	36,169	78
New Jersey	2,418,641	20,588	113
Louisiana	1,865,482	27,372	68
Tennessee	1,571,575	27,372	67
Average			82

Some of my varieties, especially Bocoboco Red, Caniang, Iningcanto and Montevideo, did very much better than the average shown above. But in the other preceding table, as it has been said, the average yield per hectare of the different varieties is much higher than the results shown in my table. A chief reason for this is doubtless the fact that my varieties were planted during unfavorable conditions. I am of the opinion that the yield may be doubled under favorable conditions.

A good yield of sweet potato in a good season, as quoted in the catalogue of the Department of Agriculture, is from 400-600 bushels per acre. A yield of from 800-1,000 bushels per acre has been obtained in experiments.

In my table the results are shown in bushels. According to the Horticulturist Rule Book, the average weight of a bushel is 53.5 lbs.

From the following table it is seen that the varieties—Manila Red, and Samar Big Yellow, yielded better in the ridge culture than in level culture. But the Beattie Camote in the level culture gave a higher computed yield per hectare than the same variety in the ridge

culture. The average of the three plants in the ridge culture is 300.78 bushels, while that of the level culture is 294.18 bushels, giving a difference of 6.60 bushels in favor of the ridge culture.

TABLE SHOWING THE RESULT OF RIDGE AND LEVEL CULTURES

Varieties	RIDGE CULTURE			LEVEL CULTURE		
	Manila Red	*Samar Big Yellow*	*Beattie Camote*	*Manila Red*	*Samar Big Yellow*	*Beattie Camote*
Date of Planting.	11–29–12	11–29–12	12– 9–12	12–11–12	12–11–12	12–11–12
Date of Harvesting	3–17–13	3–17–13	3–25–13	3–25–13	3–25–13	3–25–13
Number of Cuttings Planted. . .	184	204	158	212	239	238
Number of Marketable Tubers. .	210	523	219	281	386	367
Number of Unmarketable Tubers. .	230	408	198	174	392	198
Wt. of Marketable Tubers.	29.35 kg.	24.55 kg.	16.75 kg.	32.95 kg.	18.95 kg.	34.35 kg.
Wt. of Unmarketable Tubers. . . .	5.15 kg.	5.95 kg.	5.15 kg.	5.15 kg.	7.15 kg.	5.15 kg.
Wt. of Tubers. . .	34.50 kg.	30.50 kg.	21.90 kg.	38.10 kg.	26.10 kg.	39.50 kg.
Ave. Wt. of Marketable Tuber. . .	139.76 gms.	46.94 gms.	76.48 gms.	117.26 gms.	40.09 gms.	93.59 gms.
Ave. Wt. of Unmarketable Tuber	22.39 gms.	14.58 gms.	26.00 gms.	29.59 gms.	18.24 gms.	26.00 gms.
Ave. Wt. of Marketable and Unmarketable Tuber	81.07 gms.	30.76 gms.	51.24 gms.	73.42 gms.	29.16 gms.	119.59 gms.
Computed Number of Cuttings per Ha.	48,000	48,000	48,000	48,000	48,000	48,000
Computed Number of Marketable Tubers per Ha. .	54,720	122,880	66,440	63,360	71,520	73,920
Computed Number of Unmarketable Tubers per Ha.	60,000	96,000	60,000	39,360	78,720	39,840
Computed Wt. of Marketable Tubers per Ha.	7,606.08 kg.	5,652.48 kg.	5,049.44 kg.	7,413.12 kg.	2,868.80 kg.	6,874.56 kg.
Computed Wt. of unmarketable Tubers per Ha. .	1,320.00 kg.	1,152.00 kg.	1,560.00 kg.	1,180.80 kg.	2,270.88 kg.	1,035.84 kg.

While no definite conclusions should be derived from this experiment, because of its small scale and short duration, yet it must be said that the plants in the level culture withstood the effect of dryness better than in the ridge cultivation. Most of the plants in the ridges were badly affected by the dryness, especially the varieties, Manila Red, Samar Big Yellow and the Beattie. The latter did not have full development of the leaves and vines—being only half as well developed as the same variety in the level. Some of the varieties were as well developed in the ridge as in the level, which shows that some varieties are quite resistant to dryness and others not so.

On the whole, the plants in the level showed better vegetative growth during the dry season, which may be accounted for by the fact that the evaporation in the ridge culture is too great, due to the great ground surface exposed. The fact that the plants in the ridge gave, in general, higher yields than those in the level is for the reason that the period of dryness was short in comrison with the rainy period. The plants were planted during a rainy season and the dry season came late, when the plants were almost fully developed—so that the vegetative growth of the plants was not hindered. At the advent of the dry season the tubers were already formed and beginning to mature. But

if plants are planted during a dry season, the writer is of the opinion that the level culture is far the best method to use. This has been proven by Mr. Starnes of the Ga. Exp. Sta., Bull. 25, pp. 126-136. In 1893 and 1894, Mr. Starnes conducted an experiment comparing level and ridge cultures. The result was that the ridge beat the level in 1893, which was a rainy season, and that the level culture was better in 1894, which was a dry season.

Personally, the writer prefers the ridge culture for sweet potato if the plantation has means of irrigation so that the plants can be irrigated during a dry season. If this is impracticable, it will be better to use the level culture in dry seasons.

Adaptation of Varieties to Purposes

For early maturity for table use, Beattie, Montevideo, Bocoboco Red, Manila Red, Caniang, Magallanes and Manila White are the best varieties which we have tested. These are also heavy yielders, especially Bocoboco Red, Caniang, and Montevideo, considering their earliness. Other good varieties for table or culinary purposes are Maragadan, Iningcanto, Samar Big Yellow, Amorosa or Ucab and Beriberi. Of these Maragadan and Iningcanto gave the best yield.

For fancy colored meat for table purposes Samar Big Yellow, Maragadan and Beriberi are superior. The variety, Samar Big Yellow, is the most liked by the students of the College of Agriculture who have tested it.

Summary

While the writer does not consider that this work has covered enough time to justify any remote conclusions, yet he wishes to emphasize the fact that different varieties of sweet potato have different ability to yield and have different taste as well as color; that there are extra early, early, somewhat early, late and very late varieties; that some are easily affected by drought and some are quite resistant; that some are susceptible to disease, and others almost free from disease; and that, unless irrigation is feasible, level culture should be employed during dry seasons, and the ridge culture otherwise. The yield shown in my tables are to be considered only as comparative, being computed from small areas.

The early or first crops in the market command a good price—no matter whether they are entirely first class or not. For this purpose the following varieties may be recommended:—Montevideo, Manila Red, Bocoboco Red, as extra early; and Beattie, Iningcanto, Caniang, Magallanes, Maragadan, Beriberi, Amorosa and Ucab, as early varieties.

Field Tests of Sweet Potatoes

By Gonzalo Flor de Liza Merino

Thesis Presented for Graduation from the College of Agriculture No. 22

Introduction

The Sweet Potato as grown at present in different countries is a truck product, becoming more important from year to year. It forms a part of the people's diet in many parts of the world and in certain localities of the Philippines it is almost the only food the poorer classes have during certain seasons of the year. In some places it is raised for home consumption only and in others for commercial purposes. In the West Indies it is very widely cultivated and likewise in India; and in places where the manufacture of alcohol is an industry still more extensive raising is done. Commercially, in America, it is considered third in rank in the list of the five great truck crops and as food is only exceeded by hominy and rice. In the Philippines as food, it is probably only exceeded by rice, although the production is purely local, there being no market for a larger produce. But the industry of the world in general is yearly increasing. The consumption is not only for the home and for the market as vegetables, but also for the growing alcohol factories. The starch and sugar content of sweet potatoes as a rule average 16% and 4% respectively, making a total of 20% of alcohol-producing material. In the island of Santa Clara, one of the Azores, where the second largest alcohol factory in the world is located, from 200 to 300 tons daily are consumed or a total production of the whole season from October to January (four months) of 8,000,000 liters of alcohol. In the island of San Miguel one of the same group, about 75,000,000 kilos of sweet potatoes are raised per year, and of these 45,000,000 kilos are fed to three alcohol factories in the island. In the United States the present methods of manufacturing alcohol have not been sufficiently perfected and alcohol out of the sweet potato is not widely used. However, the possibilities of the sweet potato as a chief source of denatured alcohol in that country are great. Nor does the United States alone consider these possibilities, for Europe as well is equally interested. So this fact alone is sufficient to insure a great world industry for the sweet potato in the near future.

Origin and History

The origin of the sweet potato is a subject not yet settled. Early and present authors have a great diversity of opinion. Some have claimed America to be the original home and others give credit to the Old World. The first claim is supported chiefly by Humboldt, Meyen, and Boissier, and the second by Boyer and Choisey. The arguments in favor of an American origin are that the fifteen known species of the genus Batatas are found in America of which eleven are found in that continent alone, and the four remaining species are found in both America and the Old World; that the cultivation of the sweet potato is very widely diffused in America; that at an early date Marcgraff described it from Brazil as jetica; that the name "batata" came from a mistaken transfer of the word potato which is a Mexican word; that sweet potato is a plant much cultivated in the West Indies; that, when Columbus appeared before Queen Isabela, among his presents were sweet potatoes from the New World; that there is no native name for sweet potato among the

Malayans, and the word camote or amote is of Mexican origin; lastly that cultivation of the plant was unknown among the Greeks, Romans, and the Arabs, and in Egypt it was not cultivated even slightly, years ago. On the other hand, the Asiatic claim rests its arguments upon the facts that the Chinese Encyclopedia of Agriculture describes varieties of sweet potatoes and that Bretchneider finds that the same varieties were mentioned back in the second or third century of the Christian era. On the whole, American arguments seem to be the stronger, and the general inclination now is to believe in the American origin. As to the introduction of camotes to these Islands, Rumphius believed from general opinion that Spanish-Americans brought them to Manila and the Moluccas and from here the Portuguese diffused them throughout the Malay Archipelago.

Improvement of the Sweet Potato by Means of Breeding and Selection

The greatest and most interesting question which arises from the standpoint of farming, is the improvement of the crops in general by means of breeding or selection. To raise a crop of selected and improved seeds does not cost the grower more than to grow seeds of unselected ones and he may be benefited by the doubling or trebling of the harvest as a result thereof.

Great interest in the subject of breeding and selection has been aroused during the past twenty years or more although the subject was opened long ago by such men as Rimpau, Sheriff and Lecouteur. This interest arises from the fact that land used for planting has increased in price greatly. And to meet the higher cost of the land and of operation the yield must be increased. The general tendency of plants or even of animals under poor care is to revert more or less to the unimproved condition; that is, if no breeding and selection are done, the crop may get poorer and poorer every year, and revert more or less to its natural state.

Selection

The common practice of the small grower in selling the best tubers and selecting the small and poor ones for seed is detrimental to the raising of good sweet potatoes. This practice is generally followed in the Philippines by farmers who have not realized the possibility of improving the crops by means of selection alone.

By means of selection, the agricultural value of line-bred varieties can be improved, although with these alone we do not get new characters, but it gives us full agricultural value for the particular crop in its highest degree of productiveness and other desirable characters.

The average yields of sweet potatoes per hectare obtained in the present cultures are small if compared with the averages of hills running above average. In using the latter for seeds continually, far greater possibilities would open up for improvement in yield. The low average yield as also shown on the tables of yields is probably due to the use of seed of low vitality, giving a poor and uneven stand with a large proportion of unprofitable plants, and so giving small and unprofitable returns. To accomplish selection in the case of sweet potatoes, every individual plant is dug and weighed separately. Plants running above average are set aside for seed and those running below average are sold. The selected seeds are carefully recorded and planted as described in the following record.

Another point that we should consider in the selection of camotes is that the varieties should have good local demand and this will be based on color and texture of the flesh, and eating quality. Beyond this we should consider also resistance to diseases, and vigor and uniformity of produce, that is, uniformity of type characters. This may be outlined under the following heads:

1. Shape.—Cylindrical, oblong or obtuse are desirable shapes, while irregular, curved and ill-formed tubers account for considerable waste.

2. Color and Character of the Skin.—The character of the skin governs the appearance of tubers before and after cooking.

3. Size.—Good-sized tubers are always desirable. The larger the tuber the more mealy it is, and the more starch it contains.

4. Keeping Quality.—The potato that can be kept for a long time and sold when scarce, is the most profitable of all.

5. Color of Flesh.—Colored tubers are sometimes sold for good prices for the making of *dulces*, but generally deep-colored ones contain less starch. In the analyses of camotes for starch by Mr. Labayen, colored camotes such as the a Samar big yellow, Beriberi, and Maragadang contained less starch than those of light-colored flesh, such as the Guinarosa, Cahodo, Quinadiapa, etc.

6. Delicacy of Flavor.—This of course is of the greatest importance of all.

7. Early Maturity.—The first camotes on the market, even if not absolutely first class, command a good price.

When we breed camotes for starch we want light-colored, heavy-yielding varieties,—high in starch and low in sugar content. If for fermentation purposes for the production of alcohol, a high yield of fermentable carbohydrates, that is, sugar and starch together, is required. Of course above all these, yields per hectare are paramount. The breeding of a high content of any of the proximate constituents of the sweet potatoes is attended by many dificulties, for the seed are rarely obtained. However, this is possible, for among the camote in the college cultures, seeds were found on the Samar big yellow Canegro, Sinamporado and Beriberi. The most feasible solution of this problem that we can suggest would be to select the variety best suited for the purpose and make subsequent selections based upon chemical analyses, obtaining seeds where possible, but in any case maintaining rigid vegetative selection from the most desirable plants.

Identifications of Varieties of Sweet Potatoes

Identification of Philippine varieties of camotes was undertaken by Mr. Muñoz, a graduate of this College. He classified about eighteen varieties mostly from his home town, Ligao, Albay.

Here are described fifteen more varieties, two of which (Kinawayan and Bumatos) are from Palo, Leyte; one (the big stem Jersey), from the department of Agriculture, Washington, D. C., and the rest from Tanawan, Leyte.

The same form of key is here employed which was used by Mr. Muñoz in identifying his varieties, a device first employed by Dr. Groth of the University of Pennsylvania.

Description of Additional Varieties

1. *1080 Leyte.*

Formula.—A1 B2 C1 D2 E1-2 F2 G2-3 H2-3 I4 J2 K3 L1.

Stem 2.12 m. in length, 3mm. in diameter, green when young, pale green

when old; hair present; leaves, triangular and notched, green with purple edge and veins when young, green with purple veins when matured, mature leaves 12.5 to 13 cm. broad and 10.5 cm. long, hair absent in young leaves, hair present on edges of old leaves, star absent; petiole 12.2 cm. long, hair present; vegetation vigorous; veins green with pinkish spot at base, ribs green; matures early; tubers, some oblong, some rounded; quite free from disease, red purple skin; yellowish cream flesh, latex abundant; tubers when cooked light yellow, fine smell, excellent taste, mealy texture, fiber not visible, cooked meat yellow; flowers abundant.

2. *1081 Leyte.*

Formula.—A4 B1-2 C1 D1-2 E2 F2 G3 H3 I1 J1 K2 L3.

Stem 2.49 m. long, 4.1 mm. in diameter, green with purple stripes when young, purplish green when old, hair very scarce; leaves broad and cordate, green with light purple veins when young, green with purple veins when mature, mature leaves 9.9 to 10 cm. broad, 9.1 cm. long, hair absent when young, hair absent when old, star absent; petiole 9.5-10 cm. long, hair present on young; vegetation not vigorous; veins purple-green with purple spot, ribs some purple, some green; matures late; long and slender tubers, quite free from disease, white skin, white flesh, latex very abundant; cooked tubers, dull white, no smell, fair taste, sticky texture, fiber not visible, dull white meat; flowers very scarce.

3. *Meloqueña.*

Formula.—A5 B2 C1 D4 E2 F2 G1 H2 I1 J1 K2 L2.

Stem 2.47 m. long, 4.5 mm. in diameter, purple when young, light purple when old, hair very scarce; leaves varying in shape, purple and some green on top and purple below when young, green when mature, mature leaves 11.6 cm. broad, 10.1 cm. long, hair absent in young and old plants; star absent; petiole 14 cm. long, hair very scarce; vegetation fairly vigorous; veins purple, ribs some green some purple; matures quite early; tubers long, some obtuse, very free of disease, white skin, white flesh; latex fairly abundant; cooked tubers dull white, no smell, good taste, mealy texture, fiber quite visible, meat dull white, flowers very few.

4. *Sinamporado.*

Formula.—A4-5 B2 C1 D4 E2 F1-2 G1 H1 I4 J1-5 K3 L2.

Stem 2.5 m. long, 5.5. mm. in diameter, dark purple when young, dark purple when old, abundant hair; leaves cordate and some irregular, green with purple veins when old. Mature leaves, green with purple veins, 10 cm. broad, 8 cm. long, hair absent in old and in young; star present on some and absent on others; petiole 15 cm. long, hair abundant; vegetation fairly vigorous, veins purple, ribs purple; matures quite early; tubers slender and irregular, quite free from disease, brownish purple, rough skin, white flesh with purple streaks and purple ring on the center; latex almost absent; tubers when cooked light dull purple, no smell, no taste, mealy texture, fiber not visible, purple meat; flowers fairly numerous.

5. *Cahodo.*

Formula.—A1 B5 C1 D1-2 E2 F2 G3 H2 I3 J2 K3 L3.

Stem 2.3 m. long, 4 mm. in diameter, green when young, brownish-green when old, hair present; leaves irregular, five-notched, dark green when young green when mature; mature leaves 11.5 cm. broad, 8.5 cm. long; hair present on veins only when young and old; star absent; petiole 10.6 cm. long, hairs few; vegetation not vigorous; veins green with light purple spot; ribs green; matures quite early; tubers long, slender, quite free from disease, light

pink skin, very light cream flesh; latex almost absent; cooked tubers yellowish, dull, no smell, fair taste, sticky texture, fiber absent, yellow meat; flowers very few.

6. *Canegro.*

Formula.—A3-4 B2 C1 D3 E2 F2 G1-4 H? I1-3 J2 K2 L2.

Stem 3.79 meters long, 5mm. in diameter, greenish purple when young, green and greenish purple when old, hair absent; leaves broad, long and cordate, dark green above, and purple below when young, green when mature, mature leaves 10.8 cm. broad, 11 cm. long, hair present on veins only when young, absent in old, star absent; petiole 11.3 cm. long, hair absent; vegetation vigorous; veins green in old, purple in young; ribs green in old, purple in young; matures early; tubers, some obtuse, some rounded, some slender, very free from disease, yellowish skin with purple streaks on the stem, flesh yellow in some, others with purple mixed; latex quite abundant; cooked tubers yellow, smell like squash, excellent taste, mealy texture, fiber blurred, yellow meat; flowers fairly numerous.

7. *Caagarao.*

Formula.—A3 B1 C1 D1-2 E2 F2 G2 H3 I4 J2 K3 L3.

Stem 2.32 m. long, 3.5 mm. in diameter, green with purple stripes when young, pale green with purple stripes when old, hair present; leaves cordate, pointed, small, green with purple veins when young, pale green with purple veins when old; mature leaves 7 cm. broad, 8 cm. long, hair absent in young and old vines, star absent; petiole 9.5 cm. long, hair absent; vegetation fairly vigorous; veins green with pink spots; midribs pink, lateral ribs pale pink; matures early: tubers oblong and pointed, free from disease, dark purple skin, light cream flesh, latex almost absent; cooked tubers, yellowish cream; no smell, somewhat poor taste, sticky texture, fiber not visible, yellowish skin and meat; flowers very few.

8. *Ambay Tinampay.*

Formula.—A3-4 B2 C1 D4 E1-2 F2 G1-2 H3 I1 J2 K2 L3.

Stem 4.35 m. long, 3 mm. in diameter, dark pink when young and old, hair present but scant; leaves cordate and three-pointed, all pink when young, green with pinkish veins when old; mature leaves 11.5 cm. broad, 11.5 cm. long, hair absent in young and old, star absent: petiole 17 cm. long, hairs present but few; vegetation vigorous; veins pink; ribs pink; matures late; tubers oblong and pointed, quite free from disease, white skin, light yellow flesh; latex almost absent; cooked tubers, no change in color, no smell, good taste, mealy texture, fiber indistinct, light yellow meat: flowers very few.

9. *Tinugabang.*

Formula.—A1-4 B1 C1 D1-3 E1-2 F2 G4-3 H3 I3 J2 K2 L1.

Stem 4.87 m. long, 3 mm. in diameter, green when young, green with pinkish stripes when old, hair present; leaves broad and notched, green when young, green when matured, mature leaves 6.5 cm. broad, 7.5 cm. long, hair absent in young and old, star absent: petiole 11 cm. long; vegetation fairly vigorous; veins pale green with light pink spot at base; ribs pale green with pink spot; matures late; tubers irregular in shape, quite free from disease, light pink skin, flesh yellowish, latex abundant; cooked tubers unchanged in color, no smell, fair taste, not quite sticky texture, fiber indistinct, light yellow meat; flowers abundant.

10. *Cabulan.*

Formula.—A4 B1 C1 D1 E2 F2 G1-2 H3 I1 J1-2 K3 L3.

Stem 3.22 m. long, 4 mm. in diameter, green when young, half green and half pink when old, hair present in young,

absent in old; leaves triangular, broad at base, 3-pointed, pink and pinkish-green when young, green when mature, mature leaves 8.7 cm. broad, 8.5 cm. long, hair absent in young and old; star absent, petiole 6.5 cm. long, hair present in young, almost absent in old; vegetation fairly vigorous; veins light pink, dark pink at base; ribs pink; matures early; tubers, some rounded, some obtuse, white skin, white flesh with yellowish stripes; latex abundant, cooked tubers light yellow, no smell, good taste, not so sticky texture, fiber not visible, meat light yellow; flowers very few.

11. *Caigbao.*

Formula.—A3-5 B1-2 C1 D1 E2 F2 G4 H3 I3 J2 K1 L4.

Stem 1.64 m. long, 4 mm. in diameter, green when young, green with purple stripe when old, hair present, leaves various in shape, purple-green when young, green when mature; mature leaves 10 cm. broad, 9.5 cm. long, hair absent in young, absent in old; star absent; petiole 12.5 cm. long, vegetation vigorous; veins green, ribs green; matures early; tubers, some slender, some long, some obtuse, somewhat attacked by disease, light pink skin, yellowish-white flesh, latex abundant; cooked tubers with no change in color, no smell, fair taste, not so sticky texture, fiber visible, yellowish-white meat; flowers none.

12. *Kinawayan.*

Formula.—A1 B2 C1 D1-3 E2 F2 G1 H2 I1 J2 K1 L1.

Stem 2.64 m. long, 4 mm. in diameter, purple-green when young, purple when old, hair present, leaves cut, 5-notched, purple above, dark green below when young, green when mature, mature leaves 11 cm. broad; 10.5 cm. long; hair present on midribs only in young and old; star absent; petiole 10 cm. long, hair present; vegetation fairly vigorous; veins some purple, some half green; ribs light purple: matures early; tubers, some long, some obtuse, pointed; free from disease, white skin, light cream flesh, latex thick; cooked tubers, no change in color, no smell, good taste, mealy texture, fiber visible, light cream meat; flowering abundantly.

13. *Guinarosa.*

Formula.—A2-3 B1 C2 D3 E1-2 F2 G1-2 H3 I3 J1 K3 L4.

Stem 1.1 m. long, 3mm. in diameter, green with purple stripes when young, purple-green when old, short hair; leaves cordate, pointed, green when young, green when mature; mature leaves 8 cm. broad 8 cm. long, hair absent in young and old, star absent; petiole 8 cm. long; vegetation not vigorous; midribs light purple, and faded veins: ribs light purple; matures late; tubers irregular in shape, some long, pink skin, white flesh, latex almost absent; cooked tubers dull white, no smell, very good taste, sticky-mealy texture, dull white meat; flowers none.

14. *Guinarobasa.*

Formula.—A4-5 B2 C1 D1 E2 F2 G4 H3 I3 J2 K3 L2.

Stem 3.7 m. long, 3 mm. in diameter, green when young, brownish-green when old, hair present; leaves mixed shape, green when young, green when mature, mature leaves 13 cm. broad, 12.8 cm. long, hair absent in young and old, star absent; petiole 17.5 cm. long, hair absent; vegetation vigorous; veins green, ribs green; matures quite late; tubers long, some obtuse, free from disease, skin pinkish-yellow, flesh yellowish-cream, with rosy spots, latex almost absent; cooked tubers squash-yellow, fine smell, excellent taste, sticky and mealy texture, fiber not visible, meat similar to squash; flowers fairly numerous.

15. *Big Stem Jersey.*

Formula.—A5 B1 C1 D1 E1 F2 G4 H1 I2 J2 K2-3 L4.

Stem 2.47 m. long, 2.8 mm. in diameter, green when young and old, hair almost absent; leaves broad and 3-pointed, green when young and old, mature leaves 8.5 cm. broad, 7.5 cm. long; hair present in young and old, star absent; petiole 10 cm. long, hair present: vegetation fairly vigorous, veins green with light purple spot, ribs green; mature quite late: tubers tending to be long, some rounded, free from disease, yellow skin, yellowish-cream flesh with rosy spots, latex absent; cooked tubers squash-yellow, fine smell, excellent taste, quite sticky and mealy texture, fiber not visible, meat similar to squash in color; flowers none.

Remarks

The varieties classified in this table are from Tanawan, Leyte, with the exception of Kinawayan and Bumatos which are from Palo, Leyte, and the Big Jersey Stem from the Department of Agriculture, Washington, D. C.

The outside color of the camote can be generally foretold by looking at the stem in young shoots of the plant. That is, the color of the stem in young shoots is correlated with the color of the outside part of the tubers.

Generally pure green-vined and green-leaved camotes are the best in eating quality.

Cultural Treatment

Five separate fields were employed in the present culture. They were planted at different times of the year and given very different cultural treatment.

First Culture (Furrow Culture.)

This culture was preceded by corn and legumes. It was plowed and furrows were made one meter apart. Vine cuttings were planted about the second of April at distances of a meter in the furrows. As it was a very dry season, they were at first irrigated. Cultivation was begun by pulling the weeds and throwing the vines onto the rows. Then plowing was done between the rows so that the furrows were turned towards the rows. Harvesting was in the month of December, with the exception of the Beattie and the Samar big yellow which were harvested during the middle of November. The Beattie being a quite late-maturing variety yielded less than it ought to give. Every variety did fairly well with the exception of Gaire which is an almost tuberless variety, the Sumao, which is a poor yielder, and the Beattie, which received the poorest care.

The different varieties planted on this field and the respective yield may be seen in Table No. I.

Second Field (ridge culture)

This was a new field occupying about 1,021.20 sq. m. on the north side of the Academic Building. It was first plowed and harrowed. After it had been cleaned and put into good shape, rows one meter apart were furrowed out. Afterwards ridges were made. The vines were planted about one and a half feet in length at distances of 18 inches as recommended by the Encyclopedia of Agriculture and various bulletins. Some of the vines were planted 36 inches apart on the ridges. The plantings were made about the middle of August. The varieties used are all from Leyte, with the exception of Sumao.

The varieties planted eighteen inches apart gave yields as seen in table No. II. Harvesting was about the middle of January. Some of the varieties were badly attacked by rats.

The varieties used for the 36-inch ridge culture and the respective yields can be noted in table No. III. Hoes were used for the cultivation of this field.

THIRD FIELD (FURROW CULTURE)

This field is the largest and best culture. It lies on the east side of the baseball diamond. No cultivated plants have been recently raised on this land. Only cogon and a few cacawates grew here. The cultivation was the same as that of the first field. The furrows were eventually worked into ridges. It was given frequent cultivation. The planting of this field was begun August 19, and ended August 22. The harvesting was done from January 19 to January 27. One-half of this culture is still unharvested. Almost every one of the varieties in this culture did satisfactorily in spite of being harvested too young. The yields can be found in table No. IV.

FOURTH FIELD (RIDGE CULTURE)

This culture occupies an area north of the fence to the south of my culture No. III, beginning from the eastern end of the latter and ending at Mendiola's corn. The planting was a meter each way on ridges. The varieties occupying it are Bumatos, Guinarobasa, Casandig from Leyte, Quinadiapa from Albay, and big Stem Jersey from Washington. This culture being still immature, has not yet been harvested.

FIFTH FIELD (RIDGE CULTURE)

This culture occupies the old cassava field on the north side of the road. Ridges were made about 1 and ½ meters apart in the rows, making 4,435 plants per hektare. The varieties planted on this field are Maragadang, Bocoboco red, Manila pinkish white, Quinadiapa, Beattie, and Montevideo. The purpose of this culture is to compare the yield with that of the yield in the furrow culture. Due to immaturity they have not yet been harvested. One row of 87 plants of the Maragadang variety yielded 92,760 kilograms, an average yield per plant of 1.066 kilograms and the computed yield per hectare of 4,728.31 kilograms.

Yield

The following may be classified as heavy yielders and early maturers:

Samar Big Yellow, Iningcanto, Ucab, Montevideo, Quinadiapa, Cabulan, *1080* Leyte, and perhaps Tinugabang. As extra heavy yielders and early maturers may be mentioned Manila pula, Magallanes, Canegro, Meloqueña, Casandig, Kinawayan and Caagarao.

The poorest varieties are the Gaire and Sumao. The rest are merely fair as far as yield is concerned. The tables show the results of the cultures by different planting methods, all on unfertilized fields. With the elimination of Gaire and Sumao from the table, the oldest cultures did the best, apparently; although the culture on the track field gave the largest average yield per hectare.

If it had not been for the attacks of the rats on the 36 in. × 1 meter culture the yield on this would have equalled and perhaps exceeded the yield on the 18 in. × 1 meter culture.

Table No. V is the summarized yield-table of all the varieties on all cultures disregarding the method, treatment, and age. As shown in the table the Samar Big Yellow, an introduced variety from Samar, having the following formula A5 B1-2, C-1, D-3, E-1-2, F-1, G-3, H-1, I-3, J-4, K-2, L-1, has produced the greatest yield of all. Its yield has reached over 24 tons in one culture. Being a heavy yielder, early maturer, and of good eating quality, its cultivation is advisable. The only objection to it is its unattractive dark purple color.

The following are reports of yields of sweet potatoes in other regions:

Report of the horticulturist (F. Garcia) New Mexico Station Report, 1906, pp. 44-45.

"The sweet potato tests have given satisfaction although the crop suffered from scarcity of water and in severe hail storms. The yield from 1.53 acres was 7,081 pounds. (3,218.64 kg., about 5,849.05 kg. per hectare.)

Tropenflanzer Vol. VI, 1912, pp. 285-295. Ueber die Kultur der Batate auf den Azoren:—

In the Island of Sta. Clara, one of the islands of the Azores group, the average production of sweet potatoes per hectare with commercial fertilizers, was 25,000 to 30,000 kg. per hectare. These camotes are used for alcohol making. In the Island of San Miguel 75,000,000 kg. of sweet potatoes are produced each year, of which the three alcohol factories consume 45,000,000 kg. The average yield on these islands, run on the same basis on Sta. Clara, was 30,000 kg. per hectare.

South Carolina Agricultural Experiment Station Bulletin No. 63, June, 1901, pp. 18-19, gives the following yields. These potatoes were harvested in the year 1898. They were fertilized with different forms of Potash.

		Lbs. per acre	*Kg. per Ha.*
1.	Georgia Buck.....	19,920	22,364.72
2.	Bunch Yam.....	15,414	17,305.71
3.	Bunch Yam from different sources..	23,112	25,948.47
4.	Horton Yam.....	20,790	23,341.05
6.	Georgia Buck from different sources...	17,772	19,948.10
7.	Vineless Yam.....	19,326	21,702.37
9.	Hanover Yam.....	20,358	22,901.93
10.	Georgia Yam.....	21,306	23,920.82
	Average yield.....	19,749.75	22,181.85

The table following is from U. S. Twelfth Census showing the old varieties from all states. From this I quote only the averages:

Production from different states:

	Total.
Bushels.....	3,412,542.93
Bushels per acre.....	82
Bushels per hectare.....	202.54
Kilograms per hectare....	5,063.5

Adaptations of Philippine Varieties to Special Purposes

For table purposes, Samar big yellow, *1080* Leyte, Canegro, Beattie, Big Stem Jersey, Guinarobasa, and Amorosa are excellent. Guinarosa, Meloqueña, Tinampay, *1081* Leyte, Sinamporado, Kinawayan, Caniang, Maragadang, and Quinalabit, are very good; Cahodo, Tinugabang, Caigbao, Beriberi, Montevideo, Manila pula, Manila white or pinkish white, and Magallanes, are fair.

For hog feed; Ucab, Iningcanto, Qinadiapa are especially good for they are heavy yielders, and very vigorous. Gaire is best adapted for greens, producing only vines of soft and fine texture, which makes it desirable for this purpose.

Summary

Although the furrow culture on the average exceeded the ridge culture by 3,368 kilos, still it is not to be concluded that furrow culture is the best method for planting camotes.

The ridge culture has advantages over the furrow or level culture:

a. The roots of the plants can circulate into the loose ground and the development of tubers is not hindered by the hard subsoil.

b. During the rainy season, this is the ideal way of planting, for the tubers are easily affected by too much moisture, which causes them to rot.

The level culture has advantages over ridge culture:

a. During the dry season, the evaporation is less and the plant will not suffer very much from drought.

b. The tubers are not so badly affected by insects.

c. The tubers are not so badly attacked by rats as those in the ridge culture. Being deeper than those of the ridge the rats have more difficulty in digging them out.

Summing up all the average yields of different parts in the United States as indicated in my references, the general average of production here could be compared favorably, in spite of the entire lack of fertilizers in the present culture.

It seems that the best yield in any part of the world under favorable climatic conditions, with best soil, cultivation and fertilizers possible, does not exceed 40 tons per hectare. Here in spite of the poor soil and the lack of any fertilizers, such a yield as 24 tons or more per hectare was easily obtained. The average of three of the heaviest yielding varieties ran up to 21,283.50 kilos per hectare.

TABLE No. I.

CULTURE ON FURROWS PRECEDED BY LEGUMES AND CORN AT DISTANCES OF A METER APART

Varieties	*Ave. Yield per plant in kilos*	*Heaviest Yield per plant in kilos*	*Smallest Yield per plant in kilos*	*Computed Yield per Ha. in kg.*	*Computed Yield per Ha. of av. and above av. hills*	*Computed Yield per Ha. of hills below average*	*Age of Culture*
Amorosa	1.046	3.71	0.28	10406.7	15787.8	7293.9	8 mo. 10 da.
Beattie	0.632	2.51	0.12	6315.2	9131.8	4636.1	7 mo. 16 da.
Beriberi	1.156	3.26	0.42	11557.0	19471.4	9246.67	7 mo. 25 da.
Camiang	1.128	3.28	0.50	11275.6	15532.1	9182.7	8 mo. 21 da.
Gairę	0.166	0.38	0.061	1655.0	2657.14	990.0	9 mo.
Iningcanto	2.300	5.82	0.76	23000.8	33343.7	17327.5	7 mo. 22 da.
Manila Pula	1.032	4.72	0.33	10317.8	13814.4	17647.0	7 mo. 28 da.
Maragadan	1.100	3.56	0.10	11002.1	16504.5	6842.8	8 mo. 17 da.
Samar Big Yellow	2.416	11.67	0.69	24164.2	37313.8	17006.8	7 mo. 19 da.
Sumao	0.881	1.28	0.60	8808.0	10253.9	7170.0	8 mo. 27 da.
Montevideo	1.301	2.76	0.61	13014.8	18244.4	10400.0	8 mo. 20 da.
Ucab	2.313	4.89	1.16	23126.0	30225.0	17292.9	8 mo. 19 da.
.....	.....	.....	.....	.....	.....	.....	.....
Average	1.289	3.90	0.469	12886.9	18523.9	8569.46	8 mo. 13 da.

TABLE No. II.

CULTURE ON RIDGES PLANTED ON SOD GROUND

At distances of a meter ×18 in. apart (21885 plants per Ha.)

Varieties.	*Average Yield per plant in Kilos*	*Heaviest Yield per plant in Kilos*	*Smallest Yield per plant in Kg.*	*Computed per Ha. in Kg.*	*Computed Yield per Ha. of av. and above av. hills*	*Computed Yield per Ha. of hills below av.*	*Age of Culture*
Mcloqueña	0.571	1.31	0.23	12480.94	15872.76	9585.63	4 mo. 24 da.
1080 Leyte	0.649	1.01	0.16	14193.65	21775.58	8775.89	4 mo. 23 da.
1081 Leyte	0.426	0.80	0.16	9322.01	11796.02	7112.63	4 mo. 23 da.
Cahodo	0.490	1.10	0.15	10723.65	14925.57	7572.21	4 mo. 27 da.
Canegro	0.440	1.78	0.20	9629.40	18405.29	7265.82	4 mo. 20 da.
Tinampay	0.381	1.15	0.12	8346.99	12780.84	5383.71	4 mo. 20 da.
Sinamporado	0.438	0.73	0.12	9585.63	11752.25	6949.43	4 mo. 24 da.
Tinugabang	0.578	1.06	0.20	12649.55	16097.36	9212.59	4 mo. 20 da.
.....	.....	.....	.....	.....	.....	.....	.....
Average	0.497	1.12	0.17	10866.48	17925.7	17732.24	4 mo. 22 da.

TABLE No. III.

CULTURE ON RIDGES PLANTED ON SOD GROUND

At distances of one meter ×36 in. apart (10942 plants per ha.)

Varieties	*Av. Yield per plant in kg.*	*Heaviest Yield per plant in kg.*	*Smallest Yield per plant in kg.*	*Computed Yield per Ha. in kg.*	*Computed Yield per Ha. of av. and above av. hills*	*Computed Yield per Ha. of hills below average*	*Age of Culture*
Caigbao	0.547	2.29	0.44	5985.27	8679.19	5132.80	4 mo. 23 da.
Guinarosa	0.485	0.81	0.20	5306.87	7014.42	3949.12	4 mo. 23 da.
Cabulan	1.296	3.73	0.62	14180.83	20685.50	9081.86	4 mo. 23 da.
Casandig	1.127	3.24	0.51	12331.63	22463.93	9224.11	4 mo. 23 da.
Kinawayan	0.992	3.12	0.33	10854.46	18491.04	7034.91	4 mo. 24 da.
Sumao	0.262	0.44	0.11	2866.80	3863.47	2024.27	4 mo. 24 da.
Cagarao	1.023	1.31	0.23	11193.67	14618.51	7856.37	4 mo. 17 da.
.....	.....	.....	.....	.....	.....	.....	.....
Average	0.819	2.13	0.35	8959.93	13545.15	6330.49	4 mo. 22 da.

TABLE No. IV.

CULTURE IN FURROWS PLANTED ON SOD GROUND

At distances of a meter apart.

Varieties	*Average Yield per plant in Kg.*	*Largest Yield per plant in Kg.*	*Smallest Yield per plant in Kg.*	*Computed Yield per Ha. in Kg.*	*Computed Yield per Ha. of av. and above av. Hills*	*Computed Yield per H. of hills below average*	*Age of Culture*
Beriberi	1.104	2.66	0.43	11042.5	11763.2	10572.6	5 mo. 7 da.
Beattie	1.305	3.94	0.41	13050.0	20377.5	8877.8	5 mo. 3 da.
Camiang	1.10	2.77	0.24	10967.8	13415.9	7606.0	5 mo. 4 da.
Iningcanto	1.7	5.29	0.47	16973.3	34170.0	11410.0	5 mo. 4 da.
Magallanes	1.38	2.52	0.53	13842.4	21453.8	10046.5	5 mo. 7 da.
Montevideo	1.68	6.57	0.40	16783.0	27574.4	10919.3	5 mo. 1 da.
Quinadiapa	1.45	3.5	0.47	14537.7	20020.0	10693.6	5 mo. 4 da.
Quinalabit	1.29	2.46	0.28	12872.5	15562.5	6524.7	5 mo. 4 da.
Samar Big Yellow	1.48	4.21	0.42	14760.4	20436.4	10256.1	5 mo.
Average	1.39	3.77	0.41	13876.6	20530.4	9656.3	5 mo. 4 da.

TABLE No. V.

Varieties	*Computed yield per ha. kg.*	*Kind of Culture*
Amorosa	10406.7	Level (1st field)
Beattie	6315.2	" "
Beattie	13050.0	" (3d field)
Beriberi	11557.0	" (1st field)
Beriberi	11042.5	" (3d field)
Caniang	11275.6	" (1st field)
Caniang	10967.8	" (3d field)
Gaire	1655.0	" (1st field)
Iningcanto	23000.8	" (1st field)
Iningcanto	16973.3	" (3d field)
M. Pula	10317.8	" (1st field)
Maragadang	11002.1	" (1st field)
Magallanes	13842.4	" (3d field)
Montevideo	13014.8	" (1st field)
Montevideo	16783.0	" (3d field)
Quinadiapa	14537.7	" (3d field)
Quinalabit	12872.5	" (3d field)
Samar Big Yellow	24164.2	" (1st field)
Samar Big Yellow	14760.4	" (3d field)
Sumao	10253.9	" (1st field)
Ucab	23126.0	" (1st field)
Cahodo	10723.65	Ridge (2nd field)
Canegro	9629.40	" "
Caagarao	11193.67	" "
Caigbao	5985.27	" "
Cabulan	14180.83	" "
Guinarosa	5306.87	" "
Quinawayan	10854.46	" "
Meloqueña	12480.94	" "
Sinamporado	9585.63	" "
Sumao	2866.80	" "
Tinampay	8346.99	" "
Tinugabang	12649.55	" "
1080 Leyte	14193.65	" "
1081 Leyte	9322.01	" "